RING LASER GYRO

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Equivalents:

Abstract

PURPOSE:To obtain a ring laser gyro, which has no degradation in reliability due to the problem of coupling for taking out an output and is suitable for mass production, by forming specific ring lasers, an output waveguide, a light detector, and a nonreflecting terminal in the same substrate.
CONSTITUTION:Y branches 11a and 12a having directivity are provided in ring lasers 11 and 12 so that they are oscillated only in the reverse direction each other. They are not oscillated to the other directions since propagation loss is large. The ring laser 11 is oscillated only in the clockwise direction, and the ring laser 12 is oscillated only in the counterclockwise direction. An output waveguide 13, which forms a directional coupler that is coupled to both ring lasers 11 and 12, is provided between the two ring lasers 11 and 12. The parts of the outputs of the ring lasers 11 and 12 are taken out and synthesized, and the result is guided to a light detector 15. At the other end of the output waveguide 13, a nonreflecting terminal 14, which absorbs the reflection from the light detector 15 and natural emitted light from the ring lasers 11 and 12, is provided.

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1. TITLE OF THE INVENTION

Ring laser gyro

2. PATENT CLAIMED

A ring laser gyro comprising, in a same substrate, two ring lasers of a same diameter, having gains in mutually opposite directions, an output waveguide which is distribution coupled with the two ring lasers, a photodetector provided at an end of the output waveguide in the direction of output lights of the ring lasers, and a reflection-free end formed at the other end of the output waveguide.

3. DETAILED EXPLANATION OF THE INVENTION

(1) Technical Field of the Invention

The present invention relates to an optical gyroscope for detecting angular velocity, and more particularly to a ring laser gyro which is compact and formed in a same substrate, integrating an optical coupling unit.

(2) Prior Technology and Drawbacks

In the conventional laser gyro, a laser consisting of a discharge unit 1 and mirrors 2 as shown in Fig. 1(a) is arranged in a ring shape as shown in Fig. 2(b), and there is obtained beat signal of laser lights propagating in mutually opposite clockwise and counterclockwise directions in the laser gyro arranged in such ring shape. In order to

guide the outputs of the clockwise and counterclockwise directions to the exterior, the lights of the clockwise and counterclockwise directions transmitted through a mirror 2a are reflected by mirrors 2d, 2e and formed into the lights of a same direction by a half mirror 2f, as shown in Fig. 2. In general, such ring laser diode is utilized in detecting the angular velocity of an article positioned in the x, y, z-axes. However, such ring laser gyro is associated with a drawback that, when the angular velocity becomes small, the oscillated lights in the clockwise and counterclockwise directions generate rocking whereby the beat signal is not generated. Also a structure having the optical coupling unit in the exterior as shown in Fig. 2 is associated with a drawback of being mechanically weak so that the structure of high reliability is difficult to obtain.

On the other hand, there is also known a ring laser employing an active substance laser utilizing an active substance 6 as shown in Fig. 4(b) or a ring-shape laser 7 and guiding the output thereof to the exterior by an output waveguide 8, but, for constructing a ring-shaped laser gyro, there is associated a drawback in the structure for guiding the output to the exterior.

(3) Object of the Invention

In consideration of the drawbacks in the aforementioned conventional technologies, the object of the present invention is to provide a ring laser gyro which is capable of preventing the deterioration in reliability resulting from the coupling issue in guiding the output to the exterior and is suitable for mass production thereby being supplied inexpensively.

(4) Configuration of the Invention

The object can be attained, according to the invention, by a ring laser gyro comprising, in a same substrate, two ring lasers of a same diameter having gains in opposite directions, an output waveguide which is distribution coupled with the two ring lasers, a photodetector provided at an end of the output waveguide at the side of the output light direction of the ring lasers, and a reflection-free end at the other end of the output waveguide.

(5) Examples of the Invention

In the following examples of the ring laser gyro of the present invention will be explained in detail with reference to the drawings.

Fig. 5 shows an example of the present invention, wherein shown are a substrate 10, ring lasers 11, 12, an output waveguide 13, a reflection-free end 14, and a photodetector 15, wherein the ring lasers 11, 12 and the output waveguide are

distribution coupled.

Referring to Fig. 5, the ring lasers 11, 12 are provided with Y branches 11a, 12a of such directionality that the ring lasers 11, 12 executes oscillation only mutually opposite directions, and they do not show oscillation in the opposite direction because of a large propagation loss. More specifically, the ring laser 11 oscillates only in the clockwise direction while the ring laser 12 oscillates only in the counterclockwise direction. Between the two ring lasers 11, 12, there is provided an output waveguide 13 coupled with the two to form a directional coupler, whereby parts of the outputs of the ring lasers 11, 12 are taken out and are synthesized and guided to the photodetector 13. At the other end of the output waveguide 13, a reflection-free end 14 is provided for absorbing the reflection from the photodetector 15 and the spontaneous emission lights from the ring lasers 11a, 11b.

Fig. 6 shows another example of the present invention. In the example shown in Fig. 5, Y branches are provided in order to provide the oscillation of the ring laser with directionality, but, in Fig. 6, step differences 11a', 12a' are provided at the end of the waveguides of the ring lasers. Similarly the step difference may naturally

be provided in the direction of thickness instead of the direction of width. In Fig. 5, the ring laser 11a naturally oscillates in the clockwise direction while the ring laser 12a oscillates in the counterclockwise direction.

Fig. 7 shows still another example of the present invention. In Figs. 5 and 6, since the ring laser is excited over the entire structure, there is required a large current if the area of the ring laser has to be made large. Therefore, in Fig. 7, the excitation area is limited to 16 and 17 and the excitation is executed only in these areas while other areas are merely used as passive waveguides, wheereby the diameter of the ring can be made large.

(6) Effect of the Invention

As detailedly explained in the foregoing, the present invention is so constructed that the lights circulating in the opposite directions are synthesized in a waveguide in a same substrate to obtain a beat in the photodetector, whereby the ring laser gyro can be constructed on a single compact substrate without a light coupling portion in the exterior, without locking phenomenon of the lights in both directions, and can be provided inexpensively with high reliability. In this manner the present invention provides extremely large effects.

4. BRIEF EXPLANATION OF THE DRAWINGS

Fig. 1 is a view showing an example of conventional laser and ring laser gyro, Fig. 2 is a view showing the structure of an external take-out portion of the ring laser gyro shown in Fig. 1, Fig. 3 is a view showing three-dimensional arrangement of the ring laser gyro shown in Fig. 1, Fig. 4 is a view showing an example of the conventional semiconductor laser, Fig. 5 is a view showing an example of the ring laser gyro of the present invention, Fig. 6 is a view showing another example of the present invention, and Fig. 7 is a view showing still another example of the present invention.

10: substrate, 11, 11a, 11b, 12, 112a, 12b: ring lasers, 13: output waveguide, 14: reflection-free end, 15: photodetector, 16, 17: excitation areas.

Fig. 1
第 1 図

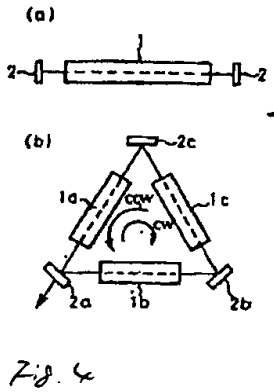


Fig. 2
第 2 図

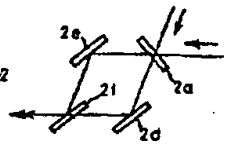


Fig. 3
第 3 図

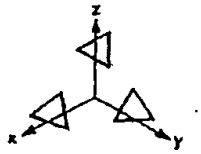


Fig. 4
第 4 図

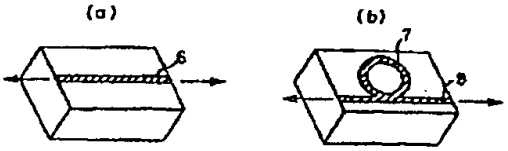
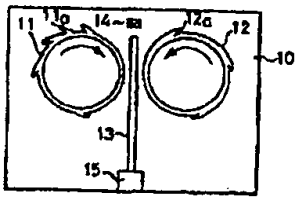
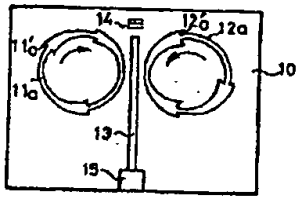


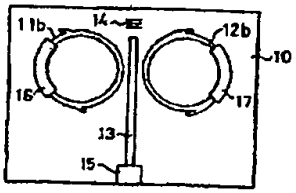
Fig. 5
第 5 図



第 6 図 Fig. 6



第 7 図 Fig. 7



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